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From the arrow of time in Badiali's quantum approach to the dynamic meaning of Riemann's hypothesis

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Abstract

The novelty of the Jean Pierre Badiali last scientific works stems to a quantum approach based on both (i) a return to the notion of trajectories (Feynman paths) and (ii) an irreversibility of the quantum transitions. These iconoclastic choices find again the Hilbertian and the von Neumann algebraic point of view by dealing statistics over loops. This approach confers an external thermodynamic origin to the notion of a quantum unit of time (Rovelli Connes' thermal time). This notion, basis for quantization, appears herein as a mere criterion of parting between the quantum regime and the thermodynamic regime. The purpose of this note is to unfold the content of the last five years of scientific exchanges aiming to link in a coherent scheme the Jean Pierre's choices and works, and the works of the authors of this note based on hyperbolic geodesics and the associated role of Riemann zeta functions. While these options do not unveil any contradictions, nevertheless they give birth to an intrinsic arrow of time different from the thermal time. The question of the physical meaning of Riemann hypothesis as the basis of quantum mechanics, which was at the heart of our last exchanges, is the backbone of this note.

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Keywords

Arrow of time, Fractional differential equation, Path integrals, Zeta functions

References

[1] Penrose R., Cycles of Time: An Extraordinary New View of the Universe, Bodley Head, London, 2010

[2] Smolin L., Time Reborn, Houghton Mifflin Harcourt, Boston, 2013

[3] Connes A., La Géométrie et le Quantique, Cours 2017, Collège de France, URL http://www.college-de-france.fr/site/alain-connes/course-2017-01-05-14h30.htm

[4] Connes A., Géométrie non Commutative, Dunod Interédition, Paris, 1990

[5] Emch G.G., Algebraic Methods in Statistical Mechanics and Quantum Field Theory, Wiley-Interscience, Hoboken, 1972

[6] Takesaki M., Tomita's Theory of Modular Hilbert Algebra and its Applications, Springer-Verlag, Berlin, 1970

[7] Araki H., In: C*-Algebras and Applications to Physics. Lecture Notes in Mathematics, Vol. 650, Araki H., Kadison R.V. (Eds.), Springer, Berlin, Heidelberg, 1978, 66-84, doi:10.1007/BFb0067390

[8] Badiali J.P., J. Phys. Conf. Ser., 2015, 604, 012002, doi:10.1088/1742-6596/604/1/012002

[9] Badiali J.P., Preprint arXiv:1311.4995v2, 2015

[10] Connes A., Rovelli C., Classical Quantum Gravity, 1994, 11, 2899, doi:10.1088/0264-9381/11/12/007

[11] Le Méhauté A., De Guibert A., Delaye M., Filippi C., C.R. Acad. Sci., Ser. IIb: Mec., Phys., Chim., Astron., 1982, 294, 865-868

[12] Le Méhauté A., Dugast A., J. Power Sources, 1983, 9, 359-364, doi:10.1016/0378-7753(83)87039-6
[13] Le Méhauté A., Crepy G., Solid State Ionics, 1983, 9-10, 17-30, doi:10.1016/0167-2738(83)90207-2
[14] Tricot C., Curves and Fractals Dimensions, Springer-Verlag, Berlin, 1999
[15] Oldham K.B., Spanier J.S., The Fractional Calculus, Academic Press, New York, 1974
[16] Le Méhauté A., Tenreiro Machado J.A., Trigeassou J.C., Sabatier J. (Eds.), Fractional Differentiation and its Applications, U-Books, Lisbonne, 2005
[17] Le Méhauté A., Fractal Geometries. Theory and Applications, Penton Press, London, 1990
[18] Nigmatullin R.R., Khamzin A.A., Baleanu D., Math. Methods Appl. Sci., 2016, 39, 2983, doi:10.1002/mma.3746
[19] Jonsher A.K., Dielectric Relaxation in Solids, Chelsea Dielectrics Press, London, 1983
[20] Le Méhauté A., Heliodore F., Cottevieille D., Revue scientifique et technique de la defense, 1992, 92, 23-33
[21] Le Méhauté A., El Kaabouchi A., Nivanen L., Comput. Math. Appl., 2010, 59, No. 5, 1610-1613, doi:10.1016/j.camwa.2009.08.022
[22] Le Méhauté A., Riot P., J. Appl. Nonlinear Dyn., 2017, 6, No. 2, 283-301, doi:10.5890/JAND.2017.06.012
[23] Riot P., Le Méhauté A., Rev. Electr. Electron., 2017, 1, 115-127
[24] Wolf M., Preprint arXiv:1410.1214, 2015
[25] Keating J.P., Snaith N.C., Commun. Math. Phys., 2000, 214, 57-89, doi:10.1007/s002200000261
[26] Herichi H., Lapidus M.L., Preprint arXiv:1305.3933v1, 2013, [IHES Preprint: IHES/M/13/12, 2013]
[27] Rovelli C., Et si le Temps N'existait pas, Dunod, Paris, 2014
[28] Schulman L.S., Time's Arrows and Quantum Measurement, Cambridge University Press, Cambridge, 1997
[29] Le Méhauté A., Nigmatullin R., Nivanen L., Flèches du Temps et Géométrie Fractale, Editions Hermes, Paris, 1998
[30] Hauet J.P., Rev. Electr. Electron., 2013, 3, 25
[31] Voronin S., Izv. Acad. Nauk SSSR, Ser. Matem., 1975, 39, 475-486 [Reprinted in: Math. USSR Izv., 1975, 9, 443-445, doi:10.1070/IM1975v009n03ABEH001485]
[32] Karatsuba A.A., Voronin S.M., The Riemann Zeta-function, Hawborn, New York, 1992
[33] Bagchi B., Math Z., 1982, 181, 319-334, doi:10.1007/BF01161980
[34] Lawvere F.W., Schanuel S., First Introduction to Categories, Cambridge University Press, Cambridge, 1997
[35] Mac Lane S., Categories for Working Mathematicians, Springer-Verlag, Berlin, 1971
[36] Borceux F., Handbook of Categorical Algebra, Cambridge University Press, Cambridge, 1994
[37] Hines P., Theor. Appl. Categories, 1999, 6, 33-46
[38] Rota G.-C., Z. Wahrseheinlichkeitstheorie, 1964, 2, 340
[39] Leinster T., Adv. Math., 2011, 226, No. 4, 2935-3017, doi:10.1016/j.aim.2010.10.009
[40] Leinster T., Basic Category Theory, Cambridge University Press, Cambridge, 2014
[41] Connes A., Preprint arXiv:1509.05576v1, 2015
[42] Aczél J., Bull. Soc. Math. Fr., 1949, 76, 59-64
[43] Aczél J., In: AIP Conference Proceedings of the 23rd International Workshop on "Bayesian Inference and Maximum Entropy Methods in Science and Engineering" (Wyoming, 2003), Erickson G., Zhai Y. (Eds.), American Institute of Physics, 2004, 195-203
[44] Craigen R., Páles Z., Aequationes Mathematicae, 1989, 37, 306-312, doi:10.1007/BF01836453
[45] Coquereaux R., Espaces Fibrés et Connexions, Centre de Physique Théorique, Marseille, 2002, URL http://www.cpt.univ-mrs.fr/~coque/EspacesFibresCoquereaux.pdf
[46] Nivat M., Perrot J.-F., C.R. Acad.-Sci., Ser. Ia: Math., 1970, 271, 824-827
[47] Howie J., Fundamentals of Semi Group Theory, Clarendon Press, Oxford, 1995
[48] Hines P., Lawson M., Semigroup Forum, 1998, 56, No. 1, 146, doi:10.1007/s00233-002-7010-6
[49] Smyth M.B., Plotkin G.D., SIAM J. Comput., 1982, 11, No. 4, 761-783, doi:10.1137/0211062
[50] Belaïche A., In: Sub-Riemannian Geometry, Belaïche A., Risler J.J. (Eds.), Birkhäuser Verlag, Berlin, 1996, 1-78
[51] Lambek J., Math. Z., 1968, 103, No. 2, 151-161, doi:10.1007/BF01110627